XII. *The Foraminifera of the Kerimba Archipelago (Portuguese East Africa).*—Part I.

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[PLATES XXXV.–XXXVII.]

INDEX.

INTRODUCTION.

THE Kerimba—or Querimba—Archipelago lies off the Eastern Coast of Africa, and extends from Cape Delgado on the North (Lat. 10° 42′ S.) to Pemba Bay (Maunhane Point, Lat. 12° 58′ S.), and studs that portion of the Indian Ocean which lies between these two points and the northern part of the Island of Madagascar, with which it is, as it were, connected by the Comoro Islands *. These islands and the sea in which they lie were made the subject of an exhaustive survey, occupying the months September 1907 to May 1908, by Dr. James J. Simpson, M.A., D.Sc., the primary object of the investigation being to consider the possibility of establishing a Pearl Fishery in these waters. The period occupied by the investigation being that of the North-east Monsoon Season, the conditions were the most favourable possible for the purpose. Dr. Simpson was thus enabled to make important collections, which have been placed in the hands of various specialists with a view to working out the contained fauna and flora, the foraminiferous sands and muds having been entrusted to us for examination.

* See the Admiralty Charts, Nos. 658 and 1809.

Unfortunately, our information regarding the geography and geology of the adjacent African coast is scanty in the extreme, but we are informed by Dr. Simpson that it consists mainly of (1) extensive sandy beaches, (2) stretches of rock-bound coast, and (3) mangrove swamps, which, as usual, mark large muddy areas. The thirty-seven main islands of the Archipelago are, for the most part, of coral formation, and are surrounded by both fringing and barrier reefs, and the great majority lie low upon the sea-level and are densely wooded. The highest altitude is attained on Wamizi Island (83 ft.), many are hardly more than rocks not more than 6–10 ft. out of water at high tide, whilst a vast number of the reefs are only uncovered at low water. The 100-fathom line, which follows the coast-line to some extent, lies at distances varying from two to twenty miles from the mainland, so that the whole district may be regarded as a semi-submerged plateau. "The most marked feature in the formation of the coast," says Dr. Simpson, "is the division into large 'passes,' and the regularity with which the islands and reefs form extensions to the Capes of the mainland. These deep indentations in the 100-fathom line between the various reefs and islands, through which the current flows to the inner bays, are known as 'passes.'"

In examining the sixteen samples of material which have come into our hands, we have been privileged to deal with what is virtually an untouched area. H.M.S. 'Challenger' left the Cape of Good Hope at Christmas, 1873, and proceeded due south-east to Prince Edward's Island and the Antarctic Circle, and never approached the east coast of Africa. In 1867 Dr. E. Perceval Wright made several dredgings in the Seychelle Islands. Only one sample from between St. Anne and Long Island was preserved, which was examined by Dr. H. B. Brady, and the results were communicated by Dr. Wright to the Royal Irish Academy in 1876 *. In this communication 38 species were noted, none of which was new to science, with the exception perhaps of a *Patellina* (No. 30) which was neither diagnosed nor named. In 1880 Dr. Karl Möbius published a highly important paper on the Foraminifera of Mauritius †, to which we shall frequently have occasion to refer in the second part of this Monograph. Möbius recorded forty species, seven of which were described as new, and his Monograph is illustrated by fourteen superb plates, dealing largely with the biological features of the group. In the year 1893, Dr. J. G. Egger published his important work on the Foraminifera collected by S.M.Sch. 'Gazelle' ‡. The Stations which particularly concern our area are as follows:—

* E. Perceval Wright, M.D. "Notes on a small Collection of Foraminifera from the Seychelles," Proc. Roy. Irish Acad. ser. 2, vol. ii. 1876, pp. 586–588.

† K. Möbius. In K. Möbius, F. Richter, and E. von Martens, 'Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen' (Berlin, 1880), pp. 63–110, "Foraminifera von Mauritius," pls. i.–xiv.

‡ J. G. Egger. "Foraminiferen aus Meeresgrundproben gelothet von 1874 bis 1876 von S.M.Sch. 'Gazelle,'" Abhandl. der k. bayer. Ak. d. Wiss., Cl. ii. Band xviii. Abth. 2 (Münich, 1893), pp. 195–457, pls. i.–xxi.

Station 65 (25 Feb., 1875), Mauritius, 137 metres.
„ 66 „ „ „ 411 „
„ 67, 20° 35′ S., 57° 17′ E., 347 „
„ 68, off Mauritius, 4801 „
„ 69, 24° 41′ 2″ S., 57° 49′ 9″ E., 4737 „
„ 71 (24 March, 1875), 32° 11′ 3″ S., 59° 41′ E., 4618 metres.

From this point the 'Gazelle' made a long series of Stations across the Indian Ocean to South Australia, and we have made a point of citing Egger's records in our synonymies.

A few fossil Foraminifera were found in the material from Station XIII. (Pemba Bay). They are apparently from at least two different geological formations, a few being pyritised fossils probably of Tertiary origin, but the majority of Cretaceous age. These species have not been included in the general paper, but will be listed for purposes of reference in an Appendix. We are at present not in the position to say whether the specimens are derived from local denudation, or whether their occurrence is due to ballast-sand thrown overboard in Pemba Harbour, Pemba being an important trading centre.

Table of Stations and Description of Material.

Station I. (Label) "Tunghi Bay. Bottom :—Sand, Mud, and Shell. Depth 5–8 fms."

A rather dark grey sand, composed of coarse and fine grains; the finer sand very dark. Bulk of material after washing :—219 cc.

Coarse material .... 43 cc. (*Orbitolites*, *Operculina*, and usual large forms).
Heavy „ .... 153 cc.
Elutriated „ .... 17 cc.
Floated „ .... 6 cc.

Tunghi Bay lies between Cape Delgado and Ras * Afunji. It communicates with the sea by Tunghi Pass (between the Islands) and with the south by Rongwi Channel. Many rare arenaceous forms attached to shell-fragments, etc., in the coarse siftings. Species and varieties identified =253.

Station II A. (Label) "Maiyapa Bay. Bottom :—Sand, Mud, and Coral. Depth 10 fms."

A dark grey sharp siliceous sand. About 40 per cent. coarser sand-grains and shell-débris. Bulk of material after washing :—319·5 cc.

Coarse material .... 250 cc. (Shells, coral-fragments, *Orbitolites*, etc.).
Heavy „ .... 45 cc. (*Operculina*, *Textularia*, etc.).
Elutriated „ .... 20 cc.
Floated „ .... 4·5 cc.

* *Ras* = Cape (Arabic).

Between Ras Afunji and Ras Nondo, communicating with the sea by Wamizi Pass, and to the south by Wamizi Channel. Arenaceous forms attached to shell-fragments. Species and varieties =176.

Station II B. (Label) "Wamizi Pass."

A jar containing a small quantity of very muddy sand in formalin, washed off larger organisms which had been preserved in tanks. Residue after washing:—6·5 cc. of clean chalk-white fine material, almost entirely composed of brilliantly white and clean Foraminifera (notably *Polystomella millettii*, sp. n.).

Wamizi Pass lies between Rongwi Island and Wamizi Island, which lie due east and west off the coast. Species and varieties =146.

Station III. (Label) "Mtundo Bay. Bottom:—Sand, Shell, and Coral. Depth 6 fms."

A dark grey sharp siliceous sand, grains varying much in size. Very little organic débris noticeable, and that chiefly molluscan. Ostracoda very plentiful. Bulk of material after washing:—87·5 cc.

Coarse material	60 cc.
Heavy "	16 cc.
Elutriated "	10 cc.
Floated "	1·5 cc.

Mtundo Bay is one of the divisions of Mazimbwa Bay, lying between Ras Nondo and Ras Msangi. Between Mtundo Island and Wamizi Island is Mtundo Pass. It communicates to the south with Tambuzi Bay by Kifuki Channel, between Kifuki Island and Ras Msangi. Species and varieties =214.

Station IV A. (Label) "Mazimbwa Bay. Bottom:—Mud. Depth 15 fms."

A dark grey siliceous sand, coarse and fine mixed. Some shell-débris.

Mazimbwa Bay lies between Ras Msangi and Ras Ulu; the two capes, twelve miles apart, are almost united by Congo Island and a curved line of reefs. It opens to the north by Meromyi Bar and to the south by Myonji Pass.

Station IV B. (Label) "Tambuzi Bay. Bottom:—Rock and Mud."

Owing to a misunderstanding, the material from these two Stations was mixed together. Bulk of material after washing:—168 cc.

Coarse material	52 cc. (Coarse mineral sand, coral-fragments, shell and algal débris, *Orbitolites*, small Echinoderms).
Heavy "	101 cc.
Elutriated "	13 cc.
Floated "	2 cc.

Tambuzi Bay lies between the line of reefs above referred to and the outer islands of Nyuni, Tambuzi, Masasari Rocks, and Myonji. It connects with the sea by Nyuni Pass and Suna Pass, and with Nameguo Bay by Tambuzi Channel. Species and varieties =185.

Station V A. (Label) "Nameguo Bay. Bottom:—Mud and Rocks."

Station V B. (Label) "Luseti Bay. Bottom:—Mud and Rocks."

Owing to the same misunderstanding, these two samples were also mixed. The mixed material is a brown-grey sand, siliceous and calcareous in equal proportions, the latter being molluscan and nullipore algal débris. Bulk of material after washing:—630 cc.

Coarse material	450 cc.	(Coarse and fine shells and coral débris; *Orbitolites*, *Operculina*, Nullipore, etc.).
Heavy ,, ...	152 cc.	
Elutriated ,, ...	20 cc.	
Floated ,, ...	8 cc.	

Nameguo Bay is a continuation of Tambuzi Bay, but is separated from it on the north by the line of reefs. It communicates with the sea by Tambuzi Pass and Nameguo Pass.

Luseti Bay lies between the line of reefs to the south of Nameguo Bay and the mainland, and communicates with the sea by Kero-Nyuni Pass. It is connected to the south with Kero-Nyuni Bay by the Kero-Nyuni Channel. Species and varieties =152.

Station VI. (Label) "Kero-Nyuni Bay. Bottom:—Sand. Depth 5–10 fms."

A dark grey muddy sand, composed of coarse and fine grains. About 25 per cent. of shell-débris and calcareous fragments. Bulk of material after washing:—1113 cc.

Coarse material (Grade 1),	350 cc.	(A tangled mass of shell- and coral-débris, and small *Modiolaria varicosa*, Gould*; *Orbitolites* and coral-fragments matted together with byssus).
,, ,, (Grade 2),	348 cc.	(Shell-débris, *Orbitolites*, *Operculina*, etc.).
,, ,, (Grade 3),	300 cc.	(Large Miliolids, *Pulvinulina*, *Gypsina*, *Operculina*, and other large forms).
Heavy ,, ...	97 cc.	
Elutriated ,, ...	14 cc.	
Floated ,, ...	4 cc.	

Between Ras Yamkumbi and Ras Pekawi. It is bounded on the north by the line connecting Ras Yamkumbi and the Wadiazi Reef, and on the south by a similar line connecting Ras Pekawi with Mjumbi Island. It communicates with the sea by Mjumbi Pass, and with the south by Pekawi Channel. Species and varieties =209.

Station VII. (Label) "Pekawi Bay. Exposed Coral-Reef."

A muddy grey-brown sand, speckled with shell-débris. A difficult sample to clean, the residue consisting largely of clayey insoluble brown granules, probably derived from decomposed coral, which adhered to one another and to the Foraminifera. Bulk of material after washing:—204 cc.

Coarse material	87 cc.	(Chiefly shell-débris).
Heavy ,, ...	110 cc.	
Elutriated ,, ...	5 cc.	
Floated ,, ...	2 cc.	

* NOTE.—Mr. G. C. Robson informs us that, so far as the Natural History Museum is aware, this species has hitherto been recorded only from Australia.

Pekawi Bay lies between Ras Pekawi and Pangane Point. It is much exposed to the sea and is only protected on the south, where Inhate and Mahato Islands form a continuation of Pangane Point. Species and varieties = 164.

Station VIII. (Label) "Molandulo Bay. Exposed Coral-Reef."

A pale grey or chalky-white sand, siliceous and calcareous, with much shell-débris. Bulk of material after washing:—419 cc.

Coarse material	180 cc.	(Large shell- and coral-débris, worm-tubes, and algæ).
Heavy " (calcareous).	52 cc.	(Molluscan fragments, *Operculina*, etc.).
" " (siliceous)..	152 cc.	(Fine sand and shell-fragments).
Elutriated "	33 cc.	
Floated "	2 cc.	

Molandulo Bay lies between Pangane Point and Kirinuzi Point, and is dotted with islands. The gathering came from the exposed Sangane Reef. Species and varieties =132.

Station IX. (Label) "Ibo Bay. (i.) Reefs around Matemo Island. (ii.) Channel between Matemo Island and the mainland. (iii.) North-east of Kerimba Island. 10–15 fms."

A single example, representing these gatherings. A dark grey coarse angular sand, with much shell-débris. Bulk of material after washing:—810 cc.

Coarse material	250 cc.	(*Orbitolites* and molluscan and algal débris).
Heavy "	340 cc.	
Elutriated "	185 cc.	
Floated "	35 cc.	

See the enlarged plan of this Bay on the Admiralty Chart No. 1809. It is protected by Matemo Island on the north and north-east, and by Kisanga Point and Ibo Island on the south and south-east. It connects with the sea by Ibo Channel between Matemo and Ibo Islands. The capital of Portuguese Nyassaland is situated on Ibo Island. Species and varieties =186.

Station X. (Label) "Montepes Bay. Bottom:—Sand and Mud. Depth 5–22 fms."

A clean, dark grey, sharp, angular sand, with a small proportion of shell-débris. Ostracoda numerous. Bulk of material after washing:—70 cc.

Coarse material	20 cc.	(Shell-débris with young mollusca; *Orbitolites, Polytrema, Nubecularia*, and many attached forms).
Heavy "	45 cc.	
Elutriated "	3 cc.	
Floated "	2 cc.	

Between Kisanga Point and Manangoroshi Point. The Bay is sheltered by Kirambo on the north, Kerimba, Teixera, and Penguin Islands on the east, and by Foomo Island on the south and south-east. It connects with the sea by the channel between Penguin and Foomo Islands, and with the south by a narrow channel between Foomo Island and the mainland. Species and varieties =179.

Station XI. (Label) "Manangoroshi Point to Lurio Point. Reefs."

A light brown sand, chiefly composed of rounded and water-worn coral-fragments, shell- and nullipore-débris. Not much fine material or mineral sand. Bulk of material after washing :—188 cc.

Coarse material	10 cc.	(Clean, rounded gravel, composed of coral-, shell-, and nullipore-débris. Large adherent forms of Foraminifera, *Homotrema*, *Polytrema*, *Gypsina*, *Placopsilina*, etc.).
Heavy „	140 cc.	
Elutriated „	30 cc.	
Floated „	8 cc.	

This sample covers a long range of inshore reef-gatherings. The whole coast is protected by Foomo Island, Kizeeva Island, and Arimba Head, which is peninsular. Between Kizeeva Island and the mainland is a narrow channel with 4 fms. of water at deepest, and between Foomo Island and Manangoroshi Point the channel is only $\frac{1}{4}$ fm. deep at low water. Species and varieties =262.

Station XII. (Label) "Lurio Point to North Point. Exposed coast. 85 fms."

A brown-grey sand, chiefly angular and siliceous. Bulk of material after washing :—533 cc.

Coarse material	140 cc.	(Shell- and nullipore-débris. *Orbitolites* and a few adherent forms, *Gypsina*, *Polytrema*, *Hyperammina*, *Haddonia*, etc.).
Heavy „	360 cc.	
Elutriated „	25 cc.	
Floated „	8 cc.	

A rock-bound coast with deep water (comparatively) close to shore. The deepest dredging in the material supplied to us. At two miles from shore no bottom was found. In this dredging, Textularidæ and Miliolidæ were exceptionally numerous. Species and varieties =201.

Station XIII. (Label) "Pemba Bay. Bottom :—Muddy. 10–20 fms."

The original gathering from this station was lost, but Dr. Simpson obtained a second sample. This was a highly organic, blue-green mud, very foul, and with little trace of calcareous material. Bulk of material after washing :—899 cc.

Coarse material	35 cc.	(Shell-fragments and large angular sand).
Heavy „	840 cc.	(Fine grey sand).
Elutriated „	20 cc.	
Floated „	4 cc.	

The sample was obtained through the courtesy of the Secretary of the Companhia do Nyassa, and was no doubt gathered under different conditions from the original sample, being apparently mud gathered from the anchorage at Pemba. Species and varieties =97.

Pemba Bay is a large natural harbour entirely land-locked, with a narrow entrance between North Point and Herbert Point. The entrance is sheltered by a peninsula culminating in Maunhane Point. The material was principally noteworthy owing to the occurrence of fossil Foraminifera in considerable numbers. (*Vide* Appendix B, p. 383,) In addition to the above-tabulated samples of material, we received from Dr. Simpson three samples of material washed from his general Zoological collections, which had been preserved in spirit or formalin. We have called these ? A, ? B, and ? X. :—

Station ? A.

This was a jar containing about 130 cc. (when washed) of *Modiolaria varicosa* Gough, with a small admixture of other shell-débris, algæ, and corals. We sifted from this 19 cc. of coarse and fine sand and calcareous fragments, and many minute specimens of the *Modiolaria*. The whole of this was examined and yielded an extensive list of forms, all of which, however, are represented in the other gatherings, the noteworthy species being *Planispirina exigua*, *Bolivina simpsoni*, sp. n., *Nummulites cummingii*, *Alveolina boscii*, *Spiroloculina crenata*, *Lagena lacunata*, *Hauerina fragilissima*, and some others. No type-slide was mounted from this example, but some of the more striking specimens have been noted in our observations. From the general facies of these siftings, it seems more than probable that the gathering came from the same neighbourhood as the material already noted under Station VI. Species and varieties =115.

Station ? B.

This was an unidentifiable but extremely rich and interesting sample, consisting of 84 cc. of material made up as follows :—

Coarse material	....	40 cc.	(Large pieces of Nullipore and coral; shells and algal débris, with fragments of Ophiurids).
Heavy ,,	....	42 cc.	(Pale grey, highly calcareous sand).
Floated ,,	....	2 cc.	(Pure Foraminifera).

If it were possible to identify this gathering, it would probably prove to come from the neighbourhood of Station X. Species and varieties =146.

Station ? X. (Label) "Montepes Bay. 30 September, 1907."

This gathering, the approximate locality of which is fortunately identifiable, consisted of a jar containing organic débris, *Zostera* grass, *Modiolaria varicosa*, and a small quantity of sand. The Foraminifera were abundant and in splendid condition, having evidently been gathered in the living state. In the jar were two large oyster-shells, which on examination have yielded a rich harvest of attached forms, including *Haliphysema tumanowiczii*, *Iridia diaphana*, gen. et sp. n., *Hyperammina vagans*, *Rhizammina algæformis*, *Crithionina mamilla*, *Sagenina frondescens*, and other similar organisms. Bulk of material after washing :—87 cc. Species and varieties =191.

Coarse material	....	5 cc.	(Molluscan débris).
Heavy ,,	....	70 cc.	
Elutriated ,,	....	10 cc.	
Floated ,,	....	2 cc.	

It will be observed, from the foregoing notes upon the material, that these dredgings will prove to be of the highest importance to students of the Foraminifera, not only on account of the fresh ground that is opened, but also by reason of the number of species recorded. We have identified and diagnosed over four hundred and sixty different species and varieties of Foraminifera from the Kerimba material, including many forms new to Science. Many of our records will be of exceptional interest, owing to the rarity or restricted distribution of the species as hitherto known, and they throw a new and most significant light upon the distribution of Foraminifera all over the world. Some northern forms are now recorded for the first time from Tropical Seas, while quite a number of species hitherto known only from the East Indian and Malay Seas are typical of the Kerimba dredgings.

The occurrence of a limited number of species usually regarded as inhabitants of brackish water is doubtless due to the numerous *wadys* and rivers on the coast. The specimens have probably been washed out to sea by floods from coastal marshes and lagoons. Many of the dredgings contain seeds and insect-remains due to the same causes.

The Kerimba material has, moreover, enabled us to work out the affinities of certain organisms which had been known to us for many years, but which we had hitherto been unable to assign to their proper position owing to the scarcity of the specimens. We have established two new genera for their reception, and we take the opportunity afforded by this introductory paper to describe and figure them in the detail which seems called for by their zoological significance.

On IRIDIA *and* NOURIA, *Two new Genera of Arenaceous Foraminifera.*

Family ASTRORHIZIDÆ.

IRIDIA, gen. n.

IRIDIA DIAPHANA, sp. n. (Pl. XXXVI.)

Thurammina papillata (?); Earland, 1905, FBS. p. 201, pl. xi. figs. 6, 7; pl. xiv. figs. 1–3; Heron-Allen and Earland, 1908, etc. SB. 1909, p. 323.

Webbina hemisphærica (?); Heron-Allen and Earland, 1908, etc. SB. 1909, p. 325, pl. xv. fig. 14.

Test adventitious, usually attached, but occasionally more or less free, consisting of a single cavity lined with a chitinous and diaphanous membrane or pellicle. The animal commences its existence as a small hemispherical dome-shaped chamber, white or light grey in colour (Pl. XXXVI. figs. 1, 2) attached to sand-grains or shell-fragments, and constructed of very fine particles of mud and sand cemented together into a rather friable test with a chitinous lining. This chitinous lining is usually continued as a "floor" to the dome-shaped chamber (figs. 4, 5, etc.), but in the youngest stage the chitinous "floor" is perhaps not always present. This early dome-stage is sometimes furnished with an aperture at the side or top of the dome (fig. 3), but quite as often no special aperture is visible. The test increases in size by the protrusion of the protoplasm in irregular masses, which proceed to secrete a covering investment of sand-grains of varying sizes, attached to the chitinous lining. The construction of the test becomes coarser with the growth of the organism, and the colour becomes darker (fig. 11). With each increase in the size of the test, the enclosing wall of the preceding stage is absorbed so as to leave an undivided cavity, the shape of which varies according to the direction and manner in which additions to the original chamber have been made. In rare instances the test spreads as a furcating tube attached to the host (fig. 12). The external surface of the organism is generally very irregular in outline, owing to the haphazard mode of growth, and the internal cavity may for the same reason become quite irregular and contorted.

The examination of the Kerimba dredgings has enabled us to clear up the uncertainty which obscured the proper affinities of the two very distinctive and curious Rhizopods figured and described in our Bognor and Selsey papers (with reservations) under the names *Thurammina papillata* Brady, and *Webbina hemisphærica* Jones, Parker, and Brady, and has revealed a fact which was not suspected by us at the time, namely, that they were but stages in the life-history of the same organism. We have now found numerous perfect and highly developed individuals, in all stages of growth, and with the protoplasmic body perfectly preserved.

Specimens are generally distributed in the Kerimba material, most abundantly at Station IX., but the finest individuals were obtained at Station X. and ? X. (which are practically identical), part of the material bearing these numbers having been preserved, in the fresh condition, in spirit. The sample from Station X. was a dredging from a bottom of sand and mud, made in depths varying from five to twenty-two fathoms in Montepes Bay; and as we have observed (*ante*) the sample ? X. is from about the same locality. At Station X. the material yielded a full series of specimens, from the primordial, minute, and dome-shaped test figured and described by us from Selsey Bill, under the name *Webbina hemisphærica* (?) J., P., & B., to fully grown individuals of relatively gigantic size.

Except in the fact that the Kerimba specimens reach a larger size than that attained by the British individuals, there is very little to add, as regards the diagnostic description of the adult form, to that supplied by Earland *ut suprâ*. The species was there described as follows:—"No two specimens are alike, some being comparatively smooth, and more or less regular in shape, while others are of the roughest construction and more or less lobate in outline. The specimens are both free and attached, and the free-growing tests are usually of much neater and more regular construction than the attached specimens. In colour they are of a light grey, and are composed of sand-grains and a grey cement. The size of the sand-grains is very variable, even in a single specimen, and frequently one or more sand-grains of relatively enormous size ($\frac{1}{6}$ to $\frac{1}{4}$ of the whole bulk of the test) are built into the test, from the surface of which they project, giving a very rough and unfinished appearance to the shell. The sand-grains are attached to a delicate chitinous membrane, that lines the cavity, and which, in detached specimens, is observable as a diaphanous film enclosing the body-cavity. The "irregularly disposed perforate papillæ," which, according to Brady, are characteristic of the test (*of* Thurammina papillata, *to which the organisms were at that time referred by Earland*), are well marked in some specimens, while in others they are entirely absent."

Comparing this original description with the Kerimba specimens, but slight modifications suggest themselves. The Kerimba tests are quite as variable in their appearance as the British, but at the same time they appear to be divisible into two groups: (i.) a simple test or dome (Pl. XXXVI. figs. 6 & 8), and (ii.) an irregularly agglomerated mass (figs. 9 & 11). The dome-form is unquestionably the initial stage, and in the smallest specimens it occasionally presents a simple orifice at the top or side of the dome, but it more often has no visible aperture. It was the absence of any aperture in the similar specimens found in the shore-sands of Selsey Bill which led us to refer the organism "with considerable hesitation" to *Webbina hemisphærica*. A fresh examination of the Selsey Bill specimens leaves no doubt in our minds that they are identical with the Kerimba individuals, or that the small domed tests represent the initial stage of the large and irregular structure subsequently developed.

The agglomerate form represents the addition of successive areas to the original "house," the line of separation between these growth-stages being usually marked by a superficial external constriction, which, however, does not correspond with any internal septum. With each addition in size, part of the previously investing wall must be absorbed, as the whole interior of a large agglomerate test forms one undivided cavity, although it is often more or less broken up by furcations of the test due to the aberrant growth of the organism.

The superficial character of the test in the Kerimba specimens is much the same as in the original British examples, but there are some differences in construction, owing to the distinctive character of the material employed, which is shell-sand, coral-fragments, sand-grains, and sponge-spicules. If anything, the fully grown Kerimba specimens are more roughly constructed than the British, and in nearly all cases they are, or have been, attached, free-growing individuals being extremely rare. The Kerimba specimens appear to be much more readily detached from the host than the British, unless this fact is due to their having lived in association with some organism of a perishable nature, such as *Zostera*, on fragments of which some specimens were found (Pl. XXXVI. fig. 2). The majority of the detached specimens have not suffered any damage to the delicate and diaphanous chitinous membrane which had been in contact with the host, and from which we have derived its specific name.

It seems probable that *Iridia diaphana* may sometimes exist in a free state on the actual sea-bottom in crannies between large sand-grains, as there are a few specimens in which both sides of a compressed test exhibit the chitinous film, the adventitious investment of fortuitous material being limited to a circumferential belt (Pl. XXXVI. fig. 10). Within this chitinous drum (so to speak) the protoplasmic body can often be clearly observed.

The protoplasmic body of *Iridia diaphana* is large, filling the greater part of the cavity even of the largest tests, and we figure an irregularly built specimen in which the body of the animal has divided into lobes which extend into every part of the "house" (fig. 9). In other instances, the protoplasm has contracted into a more or less spherical mass (figs. 8 & 10); and it may be observed that, for such a large organism, it is exceptionally free from inclusions, or metaplastic bodies, of any kind.

None of the Kerimba specimens exhibits any definite papillæ, such as were observed in a few of the Bognor specimens. In young tests, as already noted, there is often a simple aperture at the top or side of the dome, but this is not always visible. In the larger specimens, one or more irregular apertures may sometimes be traced on the surface of the test, but frequently there is no visible aperture at all, the organism communicating with the surrounding medium by interstitial orifices of minute size, situated among, and obscured by, the constituent particles of the shell-wall.

As regards the primordial dome-shaped chambers, it is somewhat noteworthy that both at Kerimba and at Selsey Bill these tests are usually found adherent to single sand-grains rather than to larger fragments (Pl. XXXVI. fig. 1). We have re-examined the Selsey Bill specimens, but have been unable to detect the presence of a chitinous "floor" in any of them. At Kerimba, on the other hand, the chitinous floor appears to be present in most (but not all) of the primordial tests (figs. 4 & 5). It may well be that this final layer of chitin is usually formed and added at a late stage in the life-history of the young domed shell.

Iridia is unquestionably a very simple and primitive form of Rhizopod, but it is not very easy to define its relationship to the other genera. In its sessile hemispherical form, its chitinous lining, and occasional papillate processes it shows affinities to the genera *Thurammina* and *Webbina* with which it was originally classed, but the aberrant and loosely constructed adult test is more suggestive of *Astrorhiza*, and it is in the family of the Astrorhizidæ that we consider that the genus should be placed. Some of the large specimens from Station IX. are strongly suggestive of the central disc of *Astrorhiza limicola* Sandahl, but lack the produced arms characteristic of that species. The genus may be regarded as being to some extent isomorphous with *Nubecularia lucifuga* Defrance.

Iridia diaphana varies enormously in size, according to the stage in its life-history and the conditions of growth. The earliest, or *hemisphærica*-stage, averages ·25 to ·3 mm. at Kerimba, similar specimens from Selsey, being considerably smaller, averaging ·15 to ·25 mm. Adult individuals show a great range in size even at the same Station, but the general average at Kerimba ranges between ·4 mm. and 1 mm. in greatest diameter of the test. The Bognor and Selsey specimens are of smaller dimensions, but exhibit the same diversity of size. At Kerimba many specimens of comparatively gigantic size were found, the largest being 8 mm. in greatest diameter. These large specimens are usually of a narrow and elongate type.

Family LITUOLIDÆ.

NOURIA, gen. n.

During the examination of the Kerimba material, we found at Stations I., III., and IX. a considerable number of specimens of a Rhizopod which, on a superficial examination, appeared to be assignable to the species *Reophax ampullacea* Brady. They attracted closer attention, however, by the fact that many of them were highly conspicuous objects, owing to the incorporation of relatively large and highly coloured mineral particles in their tests, as well as by their large size and irregular contour. These minerals stand out strikingly, by reason of their shapes and colours, from among the quartz-grains and calcareous particles of which the shell is mainly constructed.

A more careful examination of the specimens, including some mounted in balsam and others laid open for the purpose, disclosed the interesting fact that the shell, instead of being monothalamous, as in *Reophax ampullacea*, was polythalamous and that the chambers were arranged more or less spirally in a polymorphine manner.

Isomorphism with hyaline genera is a well-recognised feature in the Lituolinæ, *Reophax* being isomorphous with *Lagena* and *Nodosaria* and *Haplophragmium* with many hyaline genera (e. g., *Cristellaria*, *Rotalia*, *Nonionina*, *Globigerina*, etc.), but no case of isomorphism with the hyaline genus *Polymorphina* has yet been recorded *. Among the Kerimba specimens of *Nouria polymorphinoides* there is considerable variety of forms, comparable mainly with *Polymorphina compressa* d'Orbigny, but also with *P. oblonga* Williamson.

This discovery led us to re-examine some specimens in our cabinet from deeper water off the coast of New Zealand, which we had also referred with some hesitation to *Reophax ampullacea*. They prove, on a more critical examination, to be structurally identical with the Kerimba specimens, and are unquestionably constructed by a similar organism. The New Zealand specimens, which were found in material sent to us by Mr. R. L. Mestayer, F.R.M.S., of Wellington (N.Z.), were dredged by Captain Bollons off the Poor Knights' Islands (35° 5′ S., 174° 7′ W., depth 60 fms.). They differ considerably from the Kerimba specimens in external appearance, being much more neatly constructed, owing to the fact that the test is almost entirely built up of transparent flakes of a volcanic mineral, with a few incorporated sponge-spicules, giving a much more regularly compressed and finished appearance to the test than is observable in the somewhat coarsely constructed Kerimba shells (Pl. XXXVII. figs. 13–15). The New Zealand specimens are, as a rule, isomorphous with *Polymorphina compressa* d'Orbigny, but occasionally with *P. oblonga* Williamson.

* The species *Polymorphina silicea* Schultze ('Organismus der Polythalamien' (Leipzig, 1854), p. 61, pl. vi. figs. 10, 11) is really *Verneuilina polystropha* (Reuss), and is adopted as a synonym of that species (*cf.* Brady, 'Challenger' Report, 1884, p. 386).

NOURIA POLYMORPHINOIDES, sp. n. (Pl. XXXVII. figs. 1–15.)

Test free, bilaterally compressed, consisting of two to four or more chambers arranged in a compressed fusiform spiral. External surface moderately smooth, the constituent particles being arranged with their flatter surfaces to the exterior. Interior surface very rough, owing to the intra-projection of the more angular surfaces of the constituent grains (figs. 3 & 5). Septal lines very obscure, sometimes indicated externally by slight depressions (figs. 6, 7, 10). The walls of the chambers composed of adventitious particles—sand-grains, shell-fragments, gem-particles, and sponge-spicules—neatly cemented together. The test is less rigid than is usually the case in the Lituolidæ, and, when moistened, becomes soft and easily ruptured. Internal septa of irregular construction, and more or less incomplete. In specimens laid open, the septa are often seen to be formed by the building-in of large flattened particles (flakes of mineral, or particles of molluscan shells) which, projecting into the internal cavity, separate it into definite spaces (fig. 5). The chambers thus formed are often indicated externally by a slight inflation of the shell, a feature especially noticeable as regards the initial chamber, which may be prominent, as in some of the Polymorphinæ. The aperture is a terminal and irregular orifice closed by finer sand-grains, of which the terminal portion of the test is sometimes entirely constructed (figs. 2, 4, 6, 7, 10, 12).

Specimens of *Nouria polymorphinoides* often present a very striking appearance, owing to a tendency of the organism to incorporate in its shell relatively large mineral fragments (figs. 6, 7, 10). The "selective" tendency, however, cannot be described as being exceptionally marked in this species, either in the Kerimba or in the New Zealand specimens, the mineral fragments and shell-particles being normal constituents of its environment, but we have examples of a closely related form from several widely separated localities which exhibit the "selective" tendency in the most remarkable degree, the test being entirely composed of acerate sponge-spicules, regularly cemented together in parallel rows. We propose to take the present opportunity of describing these specimens, although they have not been found at Kerimba.

Nouria polymorphinoides varies in the relative proportions of the test, according to the varying degrees of isomorphism with *Polymorphina*. The Kerimba specimens range, on an average, between 1 and 1·9 mm. in length, and ·6 to 1 mm. in breadth. The thickness is usually rather less than the breadth. The New Zealand type is of somewhat different proportions, the length varying between ·70 and ·85 mm. and the breadth between ·25 and ·30 mm. The thickness of the shell is rarely more than half the breadth. The discrepancies are to some extent due to the neater construction and less massive material employed by the New Zealand type.

NOURIA HARRISII, sp. n. (Pl. XXXVII. figs. 16–20.)

Test free, fusiform, cylindrical to subcylindrical in section, consisting of two to four chambers arranged in a polymorphine manner and constructed entirely of sponge-spicules arranged in a single layer with their axes arranged more or less parallel to the long axis of the test. The ultimate chamber terminating in a somewhat produced neck, on which is situated the aperture of the test, which is a circular opening. The lines of demarcation between the separate chambers are marked by very slight sutural depressions, but are principally recognisable owing to a divergence of the angles at which the spicules of adjacent chambers are arranged (fig. 18). The septation of the internal cavity is very incomplete, but the different successive chambers are recognisable in section by these sutural depressions, which extend as an incomplete septum into the cavity of the test. It follows that each of these incomplete septa must originally have formed a portion of the external wall of the test which has been absorbed in the course of growth, the spicules, no doubt, being rebuilt into the new investing wall.

We first noticed this form more than twenty years ago in dredgings made by the late Captain Seabrook, and given to us by our old friend and correspondent, the late Mr. W. H. Harris of Cardiff. The dredgings in which the specimens occurred were made off Cebu in the Philippine Islands (depth 120 fms.—volcanic mud) and in the Java Sea (45 fms.). Identical specimens have since been observed in a dredging from the Sahul Bank, in the Timor Sea (50 fms.), and in a dredging off Old Providence Island in the Caribbean Sea (382 fms.). The peculiar and highly characteristic construction of the test is the same in all these widely separated localities, and, as sponge-spicules do not form any marked proportion of the bottom in any of the dredgings, the "selective" tendency must be regarded as exceptionally pronounced—almost as striking, in fact, as in our species *Technitella thompsoni* *, which, from a heterogeneous mass of available material, selects for the construction of its test nothing but the plates of an Ophiurid.

The skill—or "purpose"—exhibited by this little organism in the building of its test reaches its most remarkable development in the construction of the aperture. The spicules designed to form the terminal portion of the shell are selected by the organism of such size and shape as to form a perfectly tapered neck with a circular aperture, round which the points of the spicules often form a regular fringe (figs. 17, 18, 20). It would appear that the organism utilizes only such spicules as are suitable for its purposes owing to their tapering form, terminating in a sharp point, which allows the size of the aperture to be considerably reduced, as compared with the size which would have resulted from the utilization of broken or blunted spicules. The spicules employed are invariably of a simple type, and this is very noticeable in the Cebu specimens, as hexactinellid spicules abound in that dredging.

Specimens occasionally (but not invariably) present two or three larger spicules

* E. Heron-Allen and A. Earland. "On a new Species of *Technitella* from the North Sea, with some Observations on Selective Power as exercised by certain Species of Arenaceous Foraminifera," Journ. Quekett Micr. Club, ser. 2, vol. x. 1909, pp. 403-412, pls. xxxi.-xxxv.

projecting at a divergent angle from the wall of the shell and pointing in the direction of the aboral extremity (figs. 18, 19, 20). These projecting spicules, which to some extent mar the symmetry of the test, are, perhaps, inserted with the definite purpose of supporting the shell in an erect or vertical position in the surface-layer of mud with its aperture uppermost *.

Owing to the fact that the walls of the chambers are only one spicule thick, the organism is of an extremely friable character, and fragments are much more commonly met with than perfect specimens.

Nouria harrisii varies greatly in size according to the locality of origin, but is fairly constant at each locality. The Cebu specimens are the most typical, and average 1·1 mm. long by ·4 mm. broad. The specimen from the Caribbean Sea was considerably larger, while the individuals from the Sahul Bank, Timor Sea, were of variable sizes, but all much smaller than the Cebu specimens.

NOURIA COMPRESSA, sp. n. (Pl. XXXVII. figs. 21–26.)

Test free, highly compressed, consisting of 2–5 chambers rapidly increasing in size and arranged biserially, the walls of the test consisting of a single layer of sponge-spicules neatly cemented together into a smooth and finished surface. A grain of sand or glauconite is occasionally used to fill in a crevice between spicules (figs. 22 & 25). Marginal edges acute and usually smooth and unbroken, especially at the oral extremity of the shell. Less neat at the aboral end, where there is often a marginal fringe of projecting spicular points. Sutural lines nearly flush and obscure, but generally well marked, owing to the divergent angles at which the spicules are arranged in adjacent chambers. Aperture a neatly constructed terminal slit, sometimes with a slightly raised border or lip of cement (figs. 21, 23). Internal septa constructed of spicules and often incomplete.

In company with *N. harrisii* in the dredging from Cebu (120 fms.) were found a limited number of specimens which appear to be a highly compressed modification of that type, isomorphous with *Bolivina*. The structure of the shell as regards the employment of sponge-spicules as building-material is identical, and the arrangement of the chambers is very similar, but, instead of being cylindrical or subcylindrical in section, the tests are compressed and bi-convex, with acute marginal edges.

N. compressa exhibits one or two differences in its mode of construction, probably due to the difficulty of accommodating sponge-spicules to the peculiar shape of the flattened test. Round the edges of the test advantage is taken of the form of the spicules to obtain an unbroken periphery, but this often entails that the terminal ends

* This phenomenon may be compared with the arrangement of the spicules in the *Crinorhiza* form of deep-sea sponges, to which attention has been called by Prof. Dendy ['Outlines of Evolutionary Biology,' (London, 1912), p. 335, fig. 168], as an obvious adaptation which serves to prevent the sponge from sinking into and being smothered by the soft mud or ooze which covers the bottom of the ocean.

of the spicules project in a somewhat ragged fringe at the aboral extremity of the shell. There is also an occasional tendency to incorporate sand-grains or mineral flakes to fill up lacunæ caused by the rigid nature of the spicules (figs. 22 & 25), a feature that does not occur at all in *N. harrisii*. The aperture, instead of being terminal and circular, as in the type, is a terminal compressed slit or open fissure, and great skill is exhibited in adjusting the spicules so as to form a finished margin, which is sometimes emphasized by the building-in of a fragment of a sponge-spicule to form a terminal lip (fig. 21).

Nouria compressa does not occur within our experience, except at Cebu, where its more widely-distributed ally *N. harrisii* is also found. It is noteworthy that in the neighbouring Malay Seas, several species of Foraminifera exhibit a tendency to develop a compressed type—for example, *Bulimina elegantissima*, var. *compressa* Millett, *Bulimina marginata*, var. *biserialis* Millett, *Uvigerina auberiana*, var. *glabra* Millett, and so on. Although we are unable to account for this peculiarly local tendency to form compressed varieties, we think the habit is worthy of remark.

The few perfect specimens of *Nouria compressa* available for measurement show great discrepancies in the relative proportions of the test. This is due to the fact that any increase in the number of chambers influences the breadth of the test more than the length. The smallest specimen measured ·65 mm. long by ·40 mm. broad. This test consisted of two chambers only. The largest perfect specimen, consisting of many chambers, measured 1·25 mm. long, 1·1 mm. broad. Fragments of larger individuals were found.

Slides containing the type-specimens of the genera and species described in this paper have been deposited in the British Museum (Natural History) at South Kensington.

APPENDIX A.

Report on the Mineral Constituents of the Material examined.

By C. H. Caffyn.

[Note.—All the samples analysed represented residuum after the Foraminifera had been elutriated. The percentage of carbonates shown in the analysis is therefore no index to the proportion of calcareous material in the original dredgings.]

Fifty grains weight of each sample was taken and passed through sieves of 30, 60, and 90 holes to the inch. The portions retained by each mesh were weighed, which gives the average size of the sand.

The whole sample was then mixed again and put in 10 per cent. hydrochloric acid, which dissolved out the carbonates. The residue was washed and dried and weighed, and the carbonates estimated by difference. This percentage of loss included a small portion of muddy sediment (clay substance) which was left on the filter-paper. This sediment was black, brown, or grey, and was never more than ·5 per cent. of the original weighed sample.

The remainder was then put in bromoform (density 2·9) in a separating funnel, and divided into two portions, which were washed and dried and weighed separately.

Slides were then mounted from each portion of each sample, and the minerals were determined optically.

The chief constituent of the minerals with density less than 2·9 is quartz, which is at least 95 per cent. of this portion.

Of the heavy minerals, the chief constituent is ilmenite (titaniferous iron-ore), which is quite 75 per cent. of this portion, and in some cases more. Zircon is next in quantity, and the others are variable.

A lot of the constituents are contact-minerals, such as garnet, epidote, kyanite, sillimanite, tourmaline, and cassiterite, and I am of opinion that the sand is formed by the breaking down of a metamorphic gneiss.

The grains are subangular, which points to the sand not being far removed from its point of origin.

The samples are practically alike, and only slight differences occur. In addition to the minerals mentioned, there are a few grains of a deep blue mineral, which I cannot identify, but which may be blue tourmaline. There is also a fair quantity in each sample of a reddish-brown mineral, which sometimes shows good prism-faces with an extinction of 30 degrees. It is bi-axial, and the optical sign is negative. I cannot identify this at all.

Detailed results as follows :—

SAMPLE No. 1.

Retained by 30 sieve	20·0	per cent.	
,, 60 ,, ...	25·0	,,	
,, 90 ,, ...	41·0	,,	
Passed by 90 ,, ...	14·0	,,	
Loss in 10 per cent. HCl ..	50·0	per cent.	= Carbonates.
Lighter than 2·9........	49·0	,,	Quartz. Microcline. Soda Microcline. Orthoclase.
Heavier than 2·9........	1·0	,,	Ilmenite. Zircon. Garnet. Hornblende. Epidote. Rutile. Tourmaline. Orthite. Kyanite. Diopside. Cassiterite. Sillimanite?

SAMPLE No. 2.

Retained by 30 sieve	20·0	per cent.	
,, 60 ,, ...	65·5	,,	
,, 90 ,, ...	12·0	,,	
Passed by 90 ,, ...	2·5	,,	
Loss in 10 per cent. HCl ..	24·0	per cent.	
Lighter than 2·9........	75·0	,,	Quartz. Orthoclase.
Heavier than 2·9	1·0	,,	Ilmenite. Zircon. Garnet. Orthite. Rutile. Cassiterite. Epidote. Hornblende. Apatite. Monazite. Sphene.

SAMPLE No. 3.

Retained by 30 sieve	18·5 per cent.		
„ 60 „	34·0	„	
„ 90 „	24·0	„	
Passed by 90 „	23·5	„	
Loss in 10 per cent. HCl..	19·0 per cent.		
Lighter than 2·9	79·0	„	Quartz. Microcline. Orthoclase.
Heavier than 2·9	2·0	„	Ilmenite. Zircon. Rutile. Garnet. Hornblende. Apatite. Kyanite. Epidote. Cassiterite. Deep blue mineral unidentified.

SAMPLE No. 4.

Retained by 30 sieve	28·0 per cent.		
„ 60 „	32·0	„	
„ 90 „	15·0	„	
Passed by 90 „	25·0	„	
Loss in 10 per cent. HCl..	33·0 per cent.		
Lighter than 2·9	64·0	„	Quartz. Microcline.
Heavier than 2·9	3·0	„	Garnet. Rutile. Cassiterite. Orthite. Hornblende. Monazite. Zircon. Ilmenite. Kyanite. Epidote. Tourmaline.

SAMPLE No. 5.

Retained by 30 sieve	25·0 per cent.		
„ 60 „	38·0	„	
„ 90 „	21·0	„	
Passed by 90 „	16·0	„	
Loss in 10 per cent. HCl..	46·0 per cent.		
Lighter than 2·9	53·0	„	Quartz. Orthoclase. Microcline.
Heavier than 2·9	1·0	„	Ilmenite. Zircon. Orthite. Apatite. Tourmaline. Rutile. Monazite. Garnet. Kyanite. Cassiterite.

SAMPLE No. 6.

Retained by 30 sieve	19·0 per cent.		
„ 60 „	60·0	„	
„ 90 „	15·0	„	
Passed by 90 „	6·0	„	
Loss in 10 per cent. HCl..	37·0 per cent.		
Lighter than 2·9	62·0	„	Quartz. Microcline.
Heavier than 2·9	1·0	„	Ilmenite. Rutile. Epidote. Hornblende. Zircon. Green Spinel. Kyanite. Tourmaline.

SAMPLE No. 7.

Retained by 30 sieve	15·0 per cent.		
„ 60 „	40·0	„	
„ 90 „	24·0	„	
Passed by 90 „	21·0	„	
Loss in 10 per cent. HCl..	8·0 per cent.		Very small percentage.
Lighter than 2·9	90·0	„	Quartz. Plagioclase Felspar. Microcline.
Heavier than 2·9	2·0	„	Ilmenite. Monazite. Orthite. Cassiterite. Garnet. Zircon. Rutile. Kyanite. Tourmaline.

Sample No. 8.

Retained by 30 sieve	30·0 per cent.	
" 60 "	38·0 "	
" 90 "	18·0 "	
Passed by 90 "	14·0 "	
Loss in 10 per cent. HCl..	22·0 per cent.	
Lighter than 2·9........	75·0 "	Quartz. Orthoclase. Microcline.
Heavier than 2·9........	3·0 "	Ilmenite. Kyanite. Orthite. Garnet. Anatase? Zircon. Hornblende. Cassiterite. Tourmaline.

Sample No. 9.

Retained by 30 sieve	22·0 per cent.	
" 60 "	32·0 "	
" 90 "	24·0 "	
Passed by 90 "	22·0 "	
Loss in 10 per cent. HCl..	19·0 per cent.	
Lighter than 2·9........	76·0 "	Quartz. Microcline. Orthoclase. Plagioclase.
Heavier than 2·9........	5·0 "	Ilmenite. Rutile. Sphene. Cassiterite. Monazite. Zircon. Epidote. Tourmaline. Garnet.

Sample No. 10.

Retained by 30 sieve	21·0 per cent.	
" 60 "	22·0 "	
" 90 "	38·0 "	
Passed by 90 "	19·0 "	
Loss in 10 per cent. HCl..	20·0 per cent.	
Lighter than 2·9........	71·0 "	Quartz. Orthoclase. Plagioclase. Microcline.
Heavier than 2·9........	9·0 "	Ilmenite. Garnet. Epidote. Rutile. Zircon. Hornblende. Orthite. Tourmaline.

Sample No. 11.

Retained by 30 sieve	25·0 per cent.	
" 60 "	17·0 "	
" 90 "	35·0 "	
Passed by 90 "	23·0 "	
Loss in 10 per cent. HCl..	96·0 per cent.	Very high this. A shell sand. Average of 2 trials.
Lighter than 2·9........	3·0 "	Quartz. Microcline. Orthoclase.
Heavier than 2·9........	1·0 "	Ilmenite. Garnet. Green Spinel. Epidote. Apatite. Zircon. Hornblende. Rutile. Tourmaline.

Sample No. 12.

Retained by 30 sieve	5·0 per cent.	
" 60 "	23·0 "	
" 90 "	53·0 "	
Passed by 90 "	19·0 "	
Loss in 10 per cent. HCl..	16·0 per cent.	
Lighter than 2·9........	65·0 "	Quartz. Microcline. Orthoclase.
Heavier than 2·9........	19·0 "	Sphene. Apatite. Zircon. Sillimanite? Rutile. Orthite. Kyanite. Anatase? Ilmenite. Epidote. Hornblende. Monazite. Green Spinel.

[Note.—It is worth mentioning that I found no mica in any of the samples.]

APPENDIX B.

List of Fossil Foraminifera found at Station XIII. (Pemba Bay).

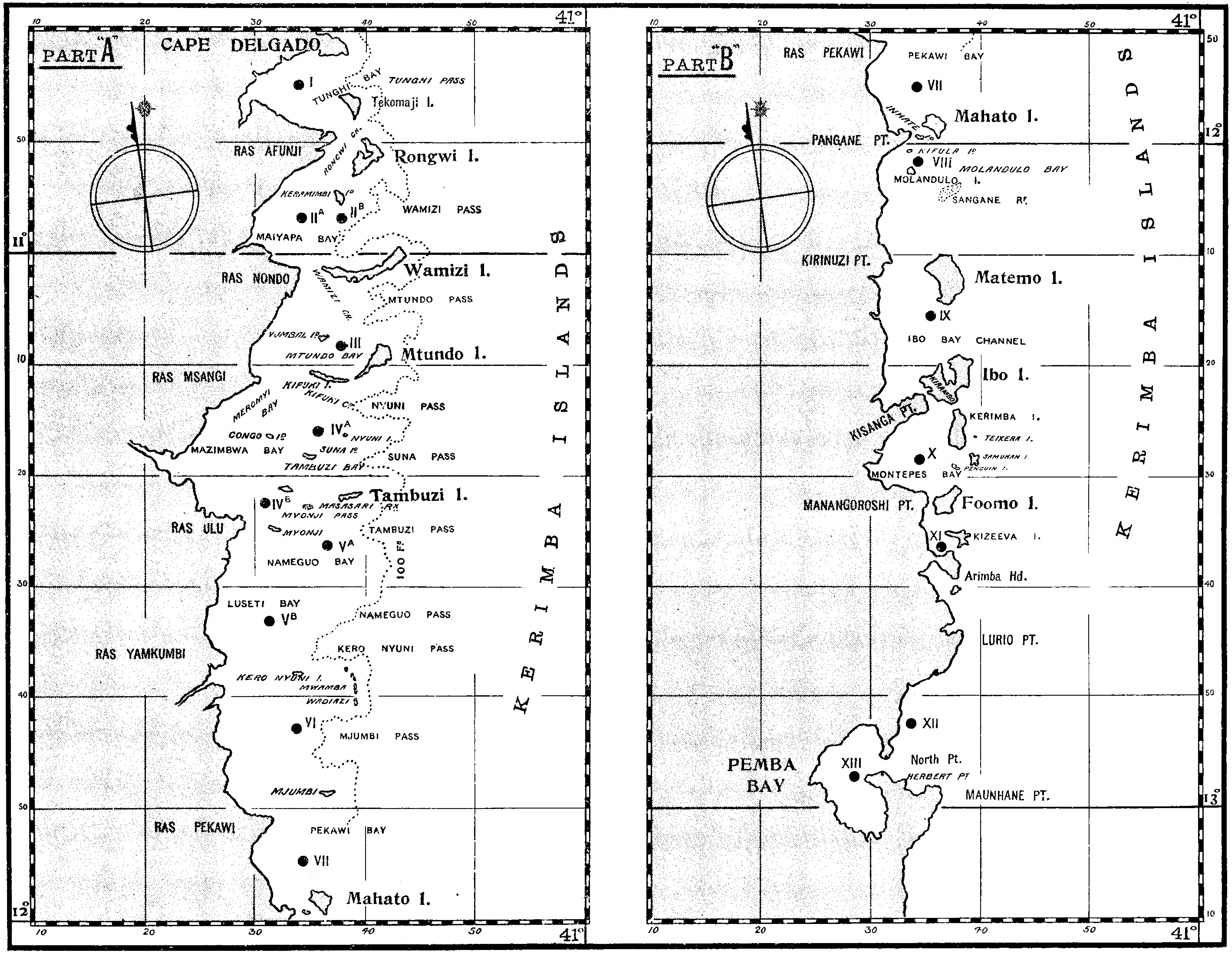
[NOTE.—C=Cretaceous; T=Tertiary.]

Peneroplis arietinus (Batsch). T.
Textularia globulosa (Ehrenberg). C.: frequent.
Bulimina pyrula d'Orbigny. C.?
„ *ovata* d'Orbigny. C.?
„ *pupoides* d'Orbigny. C.
Bolivina punctata d'Orbigny. C. & T.
Cassidulina lævigata d'Orbigny. T.
Lagena globosa (Montagu). T.
Nodosaria (Dentalina) consobrina d'Orbigny. C.
„ „ *lorneiana* d'Orbigny. C.
Rhabdogonium tricarinatum (d'Orbigny). C.
Cristellaria rotulata (Lamarck). C.
Sagrina rugosa d'Orbigny. C.
Globigerina cretacea d'Orbigny. C.: frequent.
Anomalina ammonoides (Reuss). C.
Pulvinulina micheliniana (=*truncatulinoides*) (d'Orbigny). C.
Rotalia exsculpta Reuss. C.
„ *soldanii* (d'Orbigny). C.

PLATE XXXV.

PLATE XXXV.

Map of the Kerimba Archipelago, from Cape Delgado to Pemba Bay. In Part A the 100-fathom line is indicated by a dotted line from Admiralty Chart 658; it is not indicated on Admiralty Chart 1809, from which Part B has been prepared. The reefs and smaller islands of the Archipelago have been omitted for the sake of clearness.



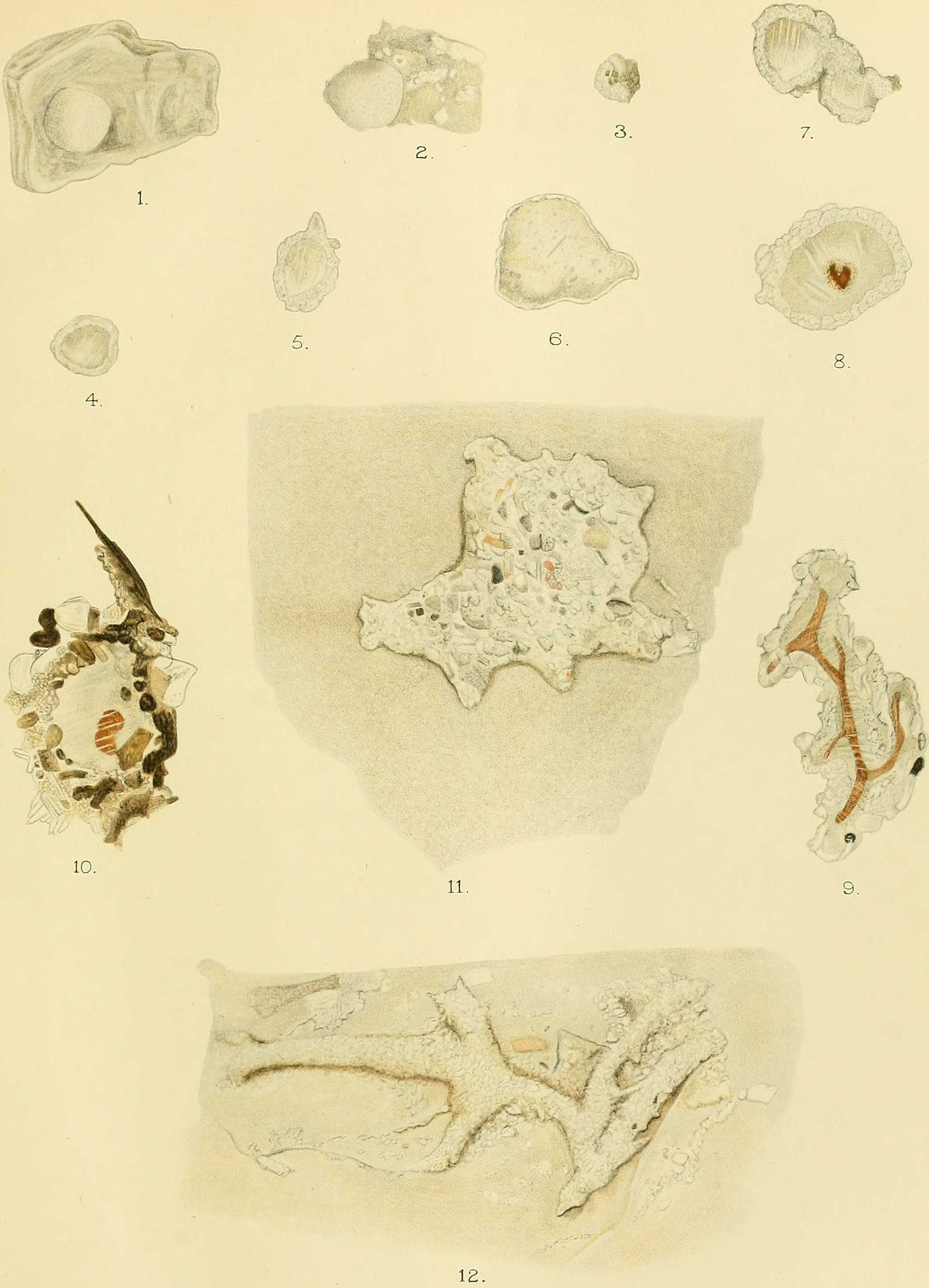
KERIMBA ARCHIPELAGO FROM CAPE DELGADO TO PEMBA BAY.

PLATE XXXVI.

PLATE XXXVI.

Iridia diaphana.

Fig. 1. Primordial stage, attached to a sand-grain. × 40.
2. Primordial stage, attached to a fragment of *Zostera*. × 20.
3. Primordial stage, specimen showing terminal aperture. × 35.
4, 5. Primordial stage, inferior surface of detached specimens, showing the chitinous pellicle across the base. × 40.
6. Adult specimen, showing superior surface. × 20.
7. Adult specimen, showing inferior surface with chitinous pellicle. × 20.
8. Adult specimen showing inferior surface. × 35. The protoplasmic body is seen in a contracted mass in the central cavity, under the transparent chitinous pellicle.
9. An adult irregularly formed specimen, showing the protoplasmic body (under the chitinous pellicle), furcating and penetrating into the different "lodges" of the test. × 20.
10. A detached specimen, which had formed its test in the crevices between sand-grains, viewed as a transparent object mounted in balsam. The contracted protoplasm is seen as a ball lying in the drum-shaped space between the two chitinous membranes. × 30.
11. A large attached specimen of a regular depressed type. × 18.
12. A large attached specimen of a wild-growing furcating type. × 12.



IRIDIA DIAPHANA.

M. Rhodes, del. ad nat.

PLATE XXXVII.

PLATE XXXVII.

Nouria polymorphinoides.

Figs. 1, 2, 4, 6, 7, 9, 10, 11. Specimens from Kerimba, showing diversity of size and form. Fig. 9 is a bilocular form, isomorphous as regards arrangement of chambers with *Polymorphina oblonga* Will.

3, 5. Specimens laid open to show the imperfectly septate cavity.

8. Oral view of a specimen showing the porous aperture filled in with fine sand-grains.

11. A specimen mounted in balsam and viewed as a transparent object. Showing the internal septation and method of construction of the test.

12. Specimen from "Poor Knights' Islands," Hauraki Gulf, New Zealand. The test is entirely constructed of obsidian flakes, and is much neater and more compressed than the Kerimba specimens.

13, 14, 15. Specimens from "Poor Knights' Islands," viewed as transparent objects in balsam. Fig. 13 shows a few sponge-spicules incorporated in the test. Fig. 15 is a bilocular specimen (*cf.* fig. 9 also), the protoplasm is confined to the earlier chamber.

Nouria harrisii.

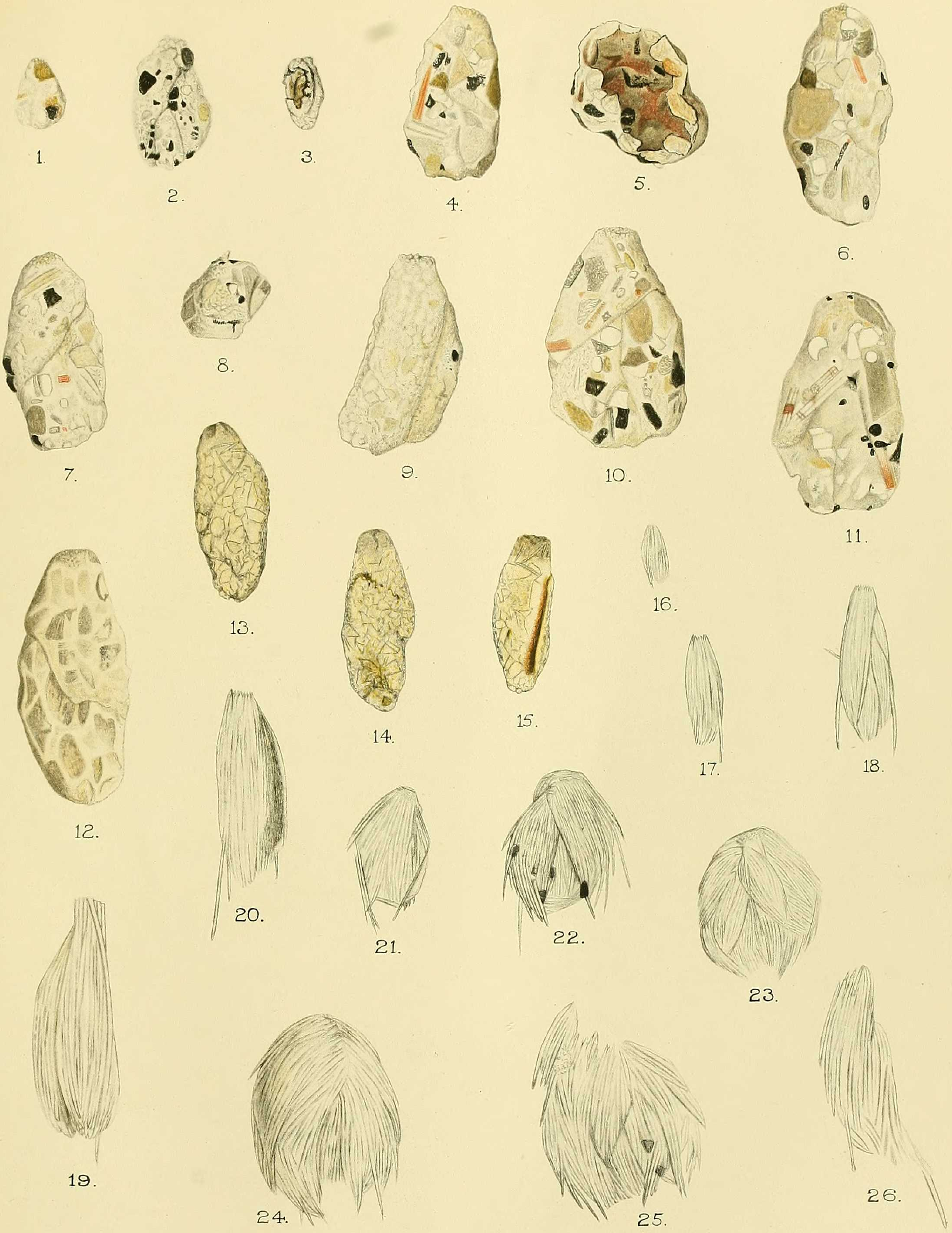
16–19. Specimens in different stages of growth.

20. Specimen viewed as a transparent object in balsam. The specimen is bilocular, and the protoplasm is confined to the first chamber.

Nouria compressa.

21–25. Specimens in different stages of growth. Fig. 21 is a young or bilocular form. The dark grains are glauconitic particles built into the test.

26. A fragment to show details of construction.



1-15. NOURIA POLYMORPHINOIDES. 16-20. N. HARRISII.
21-26. N. COMPRESSA.

M. Rhodes, del. ad nat.

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